Of Einstein, Checkerboards, and the Department of Labor:

A Short Messy Story in 11 Chapters

The Literary Club, May 9, 2016

Edward B. Silberstein

Prologue: You can't make this stuff up!

Chapter One: Storm Clouds

We have Einstein, he of $E=mc^2$, to thank or blame. You decide! In 1938 his friend, Hungarian physicist Leo Szilard, living in the United States, was the first to recognize that the neutron-driven splitting of heavy atoms such as uranium could be used to create a chain reaction and yield vast amounts of energy, for good or for destruction. Szilard became deeply concerned in 1939 when the German government stopped the sale of uranium from the recently annexed Sudetenland and wondered if the Germans were experimenting with their supply. He realized that for maximum impact a warning to the American government would have to come from someone more prestigious than he, so he arranged for Albert Einstein to sign such a warning in August, 1939. The Szilard-Einstein letter made the desired impression. A deeply concerned Roosevelt responded, "….what you are after is to see that the Nazis don't blow us up." Further rumors that Germany was working on an atomic bomb continued and finally prompted Roosevelt to authorize a full-scale development effort in January, 1942, the famous Manhattan Project. Ironically, Einstein was excluded from the Manhattan Project. As a pacifist, he was seen as a security risk. [1]

Chapter Two: Cold War

The AEC, the Atomic Energy Commission, was created after World War II to encourage and control peacetime development of nuclear science and technology. However the AEC was also overseeing, as its

highest priority, production of atomic bombs during the Cold War. No other governmental agency was given supervisory authority over important areas under AEC control, which was to prove unfortunate, as these other areas included worker and nuclear reactor safety, radiation protection standards, environmental protection, and, nuclear weaponry plant sitings.

In 1974 widespread criticism of the Atomic Energy Commission as a self-regulating agency led finally to the splitting of the AEC into the Nuclear Regulatory Commission, the NRC, and the Energy Research (read "bomb" here) and Development Administration.The Department of Energy, DOE gained full control of the Energy Research group and its bomb factories in 1977. America now had a nuclear regulatory agency legislatively separated from DOE facilities, which clearly needed regulation. But, astonishingly, the newly formed NRC also never received the authority to develop safety criteria for DOE facilities. So DOE could, and did, continue on its merry path toward environmental disaster. Now we have set the stage for Greater Cincinnati's contribution to my story. Welcome to the controversial and expensive world of the DOE Feed Materials Production Center, the FMPC, built near the tiny hamlet of Fernald, OH.

Chapter Three: Engineering, Anyone?

Having made you historians of the Nuclear Age, I must ask you to become, briefly, and I hope painlessly, chemical and nuclear engineers. The recipe for making an atomic bomb sounds easy: take an atom of a special type, or isotope, of uranium, U-235, and split it. When U-235 splits or fissions, matter is transmuted into energy, Einstein's $E=mc^2$ holds, and a lot of energy is given off, as well as nuclear particles called neutrons, which can cause more U-235 to split. Congratulations! You have now produced a chain or critical reaction with enormous multiplying effects on the energy produced. But there's a supply problem here with U-235, a big one. Natural uranium, found in rocks and dirt throughout the world, is about one hundred times more abundant than silver, but it is almost entirely comprised of the

radioisotope called U-238, with only 0.7% (7 out of 1000 parts) representing the required radioisotope, U-235. A major industrial effort must be devoted to enriching the U-235 within the U-238. That's the isotope you build bombs with! In nuclear reactors the uranium atom is not only split physically but is also chemically changed, having reacted with a lot of oxygen. This oxidized uranium is a waste product, but what a waste to toss it into the nuclear garbage pit (which sometimes did happen), if you can figure out how to reuse it. You can, with effort, get rid of that oxygen chemically, leaving the shiny metal uranium. Now the reduced metal is ready to "feed" to nuclear reactors again. That's why these forms of processed uranium are called feed materials.

The United States Geological Survey was asked by the AEC to examine sixty-two large sites wherein to combine the efforts of three older feed materials production factories. One of these, a 1050 acre site near the tiny railroad stop at Fernald, Ohio, twenty-eight miles northwest of the Queen City, contained the Great Miami Aquifer, the largest in the Midwest, but that didn't seem to disturb anyone involved. (An aquifer is a body of permeable rock, gravel or sand that contains or transmits underground water, and is the source of spring and well water.) This would be a perfect site, the AEC believed, to build the Feed Materials Production Center. There was an abundant water supply, a location situated nicely between the two major ports handling imported uranium, New York and New Orleans, flat terrain, a large workforce in the vicinity, and nearby railroad lines. In 1951 the AEC contracted with National Lead of Ohio, NLO, to recycle and produce uranium products. NLO vowed there would be no hazard, no contamination.[2]

Using the Federal Government's right of eminent domain, NLO, under AEC auspices, took the land of eleven farm families who had been living on about one thousand acres of this farm land for generations. NLO gave some families as little as thirty days to vacate. The land thus became a Federal Reserve, no longer belonging to the sovereign State of Ohio. NLO met the AEC target of FMPC completion in 1953,

with 19 acres of production facilities under roof, constructed for a mere $78 million of 1950's dollars. Who knew then that the site—we'll just call it Fernald--- was to cost the American taxpayer billions of dollars?

Chapter Four: The Cold War

In 1951 the Cold War was heating up. Russia had detonated its first atomic bomb in 1949, the year also when Communist China emerged victorious in its long civil war with Chiang Kai-Shek and his Kuomintang Party. The U.S. did have a significant lead on the U.S.S.R. in the size of its atomic arsenal and was determined to extend that advantage. Americans were worried though. Some were building bomb shelters. Kids were taught to "duck and cover." Also in the early 1950's the communist threat was perceived to be all about us, and, if we repressed that thought, Joe McCarthy and his disciples of enlightenment were omnipresent to remind us. At Fernald security was tight. Security clearances were required to be sure there were no communists among the workers, who were cautioned not to discuss their projects outside of their own production plant building, of which there were at least nine separate structures on the site. One employee, who worked at Fernald for forty-two years, explained, "I knew some of the process, but I didn't know right away that our end product was being used for weapons. I knew that we were working for the government, and I knew it was classified, so I figured it wasn't for me to know everything." [3] So there was little or no discussion of how the very separate chemical and metallurgical processes, performed at separate facilities on the incoming uranium product, related to each other, or to the final product, whatever that was. The plant workers, now referred to as "Cold War warriors", knew that they were involved in some sort of security-related work and were proud to be serving their government and protecting the safety of their country. The security label made workers very tight-lipped outside the FMPC, even with their families. In fact posters around the plant were

reminiscent of those produced during World War II, reminding the workers to "button up," and that there could be spies lurking anywhere.

Nor for most of the site's production mission, especially in the first two decades, did many residents of the nearby communities knew exactly what was being produced at Fernald, now synonymous with the Feed Materials Production Center. Was it a coincidence that the water tower at the plant was painted in a red and white checkerboard design? Many of the residents in the small surrounding communities believed for decades that this must be a site where a well-known corporation, with its checkerboard logo, produced its signature pet chow. There is no one around today to definitively confirm or deny the apparent camouflage, but it seems likely.

Chapter Five: George Orwell and Fernald Both Have Their 1984

An NLO official expressed the attitude of his company well when he wrote, "I think our permitting certain operations to continue at this site when it was known that we were well above established permissible levels has been interpreted as permission to continue to operate in this fashion as long as there are pressing production and technical requirements to be fulfilled."[4] In 1976 a report to the Rockefeller Institute criticized the operation at Fernald, suggesting that the stored waste from twenty-five years of production there could constitute a major health hazard, and that the government would not be able to dispose of this waste if its volume were allowed to accumulate unchecked. [5] And the environmental problems at the FMPC became a very public concern, beginning in the 1980's. Before this time, production was given far more emphasis than health and safety issues, for production meant money to NLO, while there was little budgeted in personnel or dollars for health and safety issues. An AEC official is even alleged to have said to NLO personnel that environmental laws could be ignored, since production was so important during the Cold War. However this changed, rather dramatically, in 1984, although that should have occurred three years earlier, because in 1981 technicians first detected

contamination with uranium in three wells being monitored outside the Fernald/FMPC property. Inexplicably, the families who drew their drinking water from these wells were not informed until 1984! Imagine learning that your own family has been drinking uranium contaminated water for three years! Lisa Crawford, founder of the citizens' interest group Fernald Residents for Environmental Safety and Health (FRESH), recalled, "The mother instincts kicked in and I became one angry person. Very angry. And the lawsuit was filed. We felt like we had no other choice." Damages for emotional distress and decreased property values were sought. The suit did not include damages due to adverse community health effects of radiation, because these had not yet been studied. Finally, in 1989, five years later the residents' groundbreaking class action suit against DOE (since NLO had federal protection) was settled for $78 million, the cost of building the original plant, and included a medical monitoring program, the results of which we shall visit later.

We return to the pivotal year of 1984 at FMPC. In March Ohio EPA inspectors found numerous violations of Ohio's hazardous waste laws. Some months later DOE admitted that about 300 pounds of enriched uranium oxide had been released to the environment over several months from a faulty plant dust collector system. Later we learned that was a really insignificant amount compared to the total over the life of the FMPC, now believed to be a million pounds, 500 tons, of uranium lost up the plant's stacks when many dust collectors were found to be either ineffective or, incredibly, nonexistent.

Then 1984 brought Fernald a bizarre and tragic event, the death of Dave Bocks. Mr. Bocks was a 39 year old FMPC pipefitter, rumored to be a whistleblower. He disappeared during the facility's graveyard shift. His remains were discovered the next morning in a uranium processing furnace. There was not enough of him, or other evidence, left to prove foul play. Some suggested this could have been an industrial accident or suicide, but his family believed it was murder. The case was profiled on the NBC television series *Unsolved Mysteries* in 1994*,* in an episode called *Whistle Blown.* Finally in 1984 DOE's self-

regulation of all its waste *appeared* to end when a U.S. District Court in Tennessee ruled that nonradioactive waste produced by DOE was not exempt from U.S. Environmental Protection Agency (EPA) hazardous waste regulations.

Although the DOE could potentially ignore the major environmental issues discovered in 1984, neverthless Fernald was getting a lot of attention and the publicity was not exactly positive. Meanwhile National Lead of Ohio did not seek, or was not offered, a contract renewal, and Westinghouse Materials Company of Ohio, a.k.a. WMCO, took over as the plant manager in January, 1986, vowing to clean up and correct all environmental and safety hazards.

Chapter Six: The Learning Curve

DOE and WMCO also decided that a FMPC Environmental Safety and Health Advisory Committee was needed. I received a call from the WMCO V.P. for Environmental Safety and Health inviting me to chair that Committee and to attend a preliminary dinner meeting with two other Company officers and himself on Jan. 29, 1986. Why me? Probably it was my apparently stupendous reputation for naiveté, gullibility, and ignorance. I did know something about radiation but little about the kind that ended up in nuclear weapons, and even less about environmental law, the rules of this game. I still retain my MasterCard receipt documenting that I paid for my dinner that night, and my share of the wine. The WMCO execs emphasized that they did not want to dwell on the past but wanted to "move ahead." I suggested that we could only move ahead when the past had been literally and figuratively cleaned up, and that no one yet had a good fix on what that would mean in time or money. I had indigestion that night, a portent to which I should have paid more attention.

To this Environmental Safety and Health Advisory Committee had been appointed a diverse and colorful group of local residents and activists as well as regional and national scientists. We arrived, however, ignorant of much that went on at Fernald. We had no engineering or manufacturing experience. Were

we just window dressing? Probably. We had to climb a steep learning curve to have any idea of what had happened at Fernald over the last thirty-five years while the Feed Materials Production Center was recycling “used” uranium oxides into uranium metal preparatory to reentry into the nuclear fuel and weapons streams. We quickly learned that the uranium recycling process generated an enormous amount of waste, about 2.5-3 pounds for every pound of uranium produced, in both solid and liquid form. Several potentially nasty chemicals were stored on site in massive tank "farms". So was asbestos. Many types of chemical waste were tossed into waste pits on site, lined with clay, rubber or plastic, none of these, shockingly, completely impermeable. Therefore a certain level of leakage must have been anticipated by NLO from the very start of utilization of these waste pits! And below the site flowed the helpless Great Miami Aquifer.

Our Committee was given a memorable tour of the Feed Materials Production Center. It seemed like some nightmarish junk yard, littered with empty and full barrels randomly distributed about the premises, sagging buildings in need of repair, and worker practices that looked unsafe. In one plant we saw a strange green material with the consistency of saw dust lying around the building, even coating the windows, some of which were opened on that chilly February day, the only way for the workers to see daylight, so dense was the accumulation of the green stuff. The green stuff, “green salt," they called it, was uranium tetrafluoride, an intermediate in the reduction of uranium oxide to uranium metal. The workers were supposed to wear respirators when green salt was not contained, but they had their own brand of machismo, and we learned that in the fifties and sixties “real men” didn’t always employ them. After all, they were working for Uncle Sam who would watch out for them, so that came first before the uncomfortably warm masks. They were uncomfortable! Also sitting around in at least one facility were stacks of shiny three foot cylinders covered with a tarpaulin. This was, in fact, metallic uranium! Fortunately, the kind of radiation coming immediately out of uranium is the alpha particle, which cannot penetrate skin. The problem was that if inhaled or swallowed in a more soluble form like green salt, such

radiation could cause cell damage, theoretically leading to intestinal or lung cancer, the latter especially in smokers. Also several silos on the FMPC reservation, we learned, had been useful to the DOE as sites to store processed pitchblende residue, a brown/black mineral with a pitch-like luster containing uranium and radium obtained not only from our own Manhattan Project, but also from South Africa, Australia, and the former Belgian Congo. Much of the uranium in the pitchblende was separated out for further processing at FMPC. The residue, a waste byproduct called K-65, contained a large amount of radium, and was a significant source of radon-222, generated from radium as a colorless, odorless, potentially carcinogenic gas, which was leaking from the K-65 silos. Radon can pass through cement, especially cement with cracks in it, and radon gas was detected on site in the '60's and 70's when remediation attempts included pouring foam over the silo contents (making them much heavier to remove), and finally, and more successfully in 1979, by building barriers over and around the K-65 silos. Fortunately, this radioactive gas is greatly diluted by non-radioactive air to such an extent that at the FMPC boundary line the radon levels by 1989 had decreased to the low concentrations found in distant parts of Hamilton County. Nevertheless this radon-222 became yet another source of fear in the surrounding communities. Not only radium but also thorium-232, a source of a type of uranium used in the costly Breeder Reactor Project at Clinch River, TN, was also processed, and finally entirely stored, at the FMPC. The silos which held the radium and thorium could not have withstood the direct hit of a plane, tornado, or a level seven earthquake. These were deemed most unlikely events, of the order of one in a million….like Chernobyl and Fukushima.

Chapter Seven: An Unheavenly Marriage

By 1986 the DOE felt sufficient governmental and public pressure that the Dept. of Energy signed the Federal Facilities Compliance Agreement with EPA, apparently agreeing to collaborate assessing and cleaning up Fernald, thus complying with six major environmental statutes relating to hazardous waste,

air and water pollution, performance of a formal Environmental Impact Study before any remediation could begin, and the penalties to be assessed. It appears that the signees were holding crossed fingers behind their backs. These EPA, mandates contain, by my count, 313 abbreviations, actually requiring a separate glossary. My favorite abbreviations in these bewildering literary masterworks included:

-LUST, “leaking underground storage tanks”;

-the very hip BDAT, “best demonstrated available technology”;

-EROS, which should be a companion to LUST, disappointingly meant “emerging response operational services." There are many more laughers in this material!

The next few years were consumed with assessing the size of the environmental problems, debating alternative solutions, and beginning remediation. Characterization of the waste pits was an early step in remediation and determining how to clean up the site. There was a debate whether the wells, and hence the Great Miami Aquifer, were contaminated by surface runoff or from leaks under the waste pits, but this tragedy was probably the result of both processes. After all, the waste pits contained over eleven million pounds of uranium and the entire country’s supply (176,000 pounds) of thorium-232, so it is not difficult to imagine some of this poorly soluble material seeping through pit linings which, outrageously, NLO knew were not fully impermeable.

Meanwhile WMCO had a contractual obligation to continue production, but the company had little environmental cleanup expertise. WMCO tried. Yet we saw problem after problem appear, such as an unauthorized worker venting one of the radon-containing K-65 silos, and a testing failure of sirens to warn of chemical or radiation leaks, the installation of which our Committee had managed to hasten by a year (with a little help from Senator John Glenn). We discovered that some blank specimens, used as controls in measuring uranium samples, were incorrectly reported to have uranium levels in them by the

EPA lab Fernald used.[7] While documents concerning each phase of construction were submitted to the EPA, the EPA Environmental Impact Statement process was bypassed. To the credit of the DOE/WMCO, the structure of EPA requirements was adhered to without the EPA taking control of DOE business. The fact remained that the Federal Facilities Compliance Agreement was unenforceable. There was no agency which could force the DOE to follow the EPA regulations, although this 1986 Agreement between the DOE and EPA had stated that the Office of Management and Budget and the U.S. Department of Justice would “insure compliance with the environmental laws." That never occurred.

In June, 1989, DOE Secretary James Watkins blew his own stack and announced a ten point plan which would enhance collaborative oversight of the cleanup process. Meanwhile the recycling process for uranium went on. However the President of WMCO met me for lunch one summer day in 1989 to tell me that his company would have to stop production of all uranium products and focus solely on cleanup, as the investigations into environmental and safety issues had identified an overwhelming number of issues which needed remediation quickly.

A year later, in 1990, the Fernald workers filed their own class action suit and won a $20 million settlement four years later plus life-long medical monitoring completed on them. The delay was caused by DOE lawyers, for whose efforts the DOE spent $15 million fighting the workers’ claims for emotional anguish. Again, there was still no valid health effects study. Also in 1990 the DOE and EPA entered into yet another agreement setting forth legally binding cleanup progress milestones, finally resolving the four year struggle between the agencies.

Chapter Eight: Changing Horses in Midstream

WMCO labored on, but in 1992, eight years after the multiple debacles of 1984 had called public attention to the Fernald issues, the DOE finally had the remarkable insight that it was time to stop relying on a weapons contractor and *perhaps* hire an environmental restoration management company. The winner of the bidding was Fluor Daniel, Inc. and their local subsidiary became FERMCO, the Fernald Environmental Remedial Management Corporation of Ohio, which later became Fluor Fernald. Labor disputes promptly erupted over firings of former WMCO employees by FERMCO, billing DOE for fancy company dinners, and the infamous L.L. Bean Incident. Apparently FERMCO thought that the DOE just might be the couturier they needed and ordered a large quantity of L.L. Bean fancy and expensive jeans for FERMCO community outreach workers, charging DOE. DOE Secretary Watkins was apoplectic over that one. FERMCO also had issues in training, containing leaky barrels, schedule delays, and cost overruns. A bizarre FERMCO community outreach attempt was the creation of their newly conceived board game, Cleanupoly, where one tried to get around the board without having to go back to Congress for more money. The game's inventor admitted, “As a game, it’s a little weak.”[9]. FERMCO public relations took another blow when the Enquirer reported that Hamilton County Coroner Frank Cleveland, who was labeled a “body snatcher” by some, had, without informed consent of relatives, sent samples of tissue, if not whole organs, of deceased employees and eleven private citizens during the 1950's and 1960's to a Fernald lab for determination of tissue radioactivity. Dr. Cleveland fought back and was quoted as saying, “So human samples are of prime importance, and if anybody knows how to do a good job of body snatching, they will be serving their country.” [10]

Chapter Nine: Are We There Yet?

Five enormous remediation areas were eventually identified by the DOE and Federal and State EPA's:

1. the waste pits were to be dug out, dried, and shipped to an approved storage site in Utah or Texas;

2. ash, trash, and rubble, had to be buried in a 3000 foot long, 65 foot high mound on site, after it became apparent that the cost of shipping out this huge amount of waste, 80% of the total, was prohibitive and the radiation levels coming from these materials were low;
3. 323 buildings on site needed to be leveled;
4. the three silos containing the dangerous K-65 radium/radon material and thorium-232 had to be safely emptied, dried, and shipped to a West Texas facility for burial deep underground;
5. contaminated soil had to be removed and buried in that Fernald mound, while contaminated water would have to be recycled and decontaminated for years (through 2016 and beyond).

Potent carcinogens were found in trace amounts in some of the waste pits, along with, predictably, thorium and uranium. It was determined that during the period of production at Fernald, 1951-1989, of 232,600 tons of uranium and byproducts which had been processed at the site, about 500 tons of uranium had been lost into the atmosphere and, 85 -110 tons into the Aquifer, representing together 0.2% of all uranium handled at Fernald lost to the environment. Almost 5,500 tons of this metal, another 2% of the total, were found in waste pits or the site's soil. However FERMCO finally was able to take control of the situation and would steadily remove, package, store and ship both radioactive and nonradioactive chemical waste to that specialized Texas site. Other waste went to the Nevada Test Site or a federal storage area in Utah.

The last uranium shipment would not occur until May, 2006 because of the complex engineering and safety problems which had to be solved during this remarkable and expensive remediation. In Oct., 2006, Fluor Fernald, the former FERMCO, announced the final closure of the plant and then, with much fanfare, there occurred an administrative handover of the site to the new D.O.E. Office of Legacy Management, which renamed the site the Fernald Preserve. The Office of Legacy Management is

responsible for monitoring, at last count, 19 DOE facilities still closely watched after almost, but not quite complete, DOE site cleanup.

Chapter Ten: Thresholds

But my story is not yet complete. The fear of the human toll from potential exposure to radiation from nuclear waste around the country was great, especially among the nearby residents of communities like Fernald. Let's look closely at the relevant data. Survivors of the atomic bomb at Hiroshima and Nagasaki have been followed to the present time very closely by a joint Japanese-American scientific group, and cancer incidence has been measured precisely. In the years 1958-1998 after the atomic bomb exposure, there were 105,427 Japanese cohort members. Each had detailed individual radiation dose estimates who were not known to have cancer prior to the study initiation in 1958. Of the total cohort of 105,000+, 848 people, less than 1% of those exposed, were estimated to have contracted a radiation related cancer.[11] But if these 848 cancers in a population of 105,000 exposed to high dose and high dose rate radiation, it does not follow that low dose and low dose rate radiation must cause cancer *if t*here is a threshold for this effect. Common sense provides supporting evidence for a threshold for carcinogenesis. Many of us enjoyed buying shoes as kids because we could look at live x-rays of our feet under a fluoroscope. Has anyone had a cancer of the feet? Also we are all constantly receiving radiation from outer space called cosmic rays. The higher the elevation of your residence, the more cosmic rays hit your body. In mile-high Denver citizens receive 65% more radiation than we do in the Queen City. But there is no increase in cancer prevalence in Denver relative to Cincinnati, again indicating a threshold for radiation carcinogenesis.

So what do we know? In determining causality, i.e., convincing evidence of cause and effect, one must demonstrate a dose-response effect for the putative causative factor and the cancer. This means that the higher the dose of carcinogen, the more cancers there must be. Factory workers who used certain

chemicals on site, including trichloroethylene, cutting fluids and kerosene, *did have an increased the risk of several digestive-tract cancers*, a finding made more credible as the risk of cancer from these toxic chemicals increased with duration and level of exposure.[12] And was there a carcinogenic effect from the radiation exposure? Such *dose-response evidence also existed for the workers for intestinal cancer*s, where the data are somewhat confounded by those chemical exposures associated with the same cancers. The incidence of cancer of the blood and lymphatic system and lung was also somewhat increased, but, importantly, no radiation dose-response relationship was detected in these latter data. The lung cancer data were also muddled by the fact that many workers smoked heavily, but their smoking histories, especially from the 1950's and 1960's, were not always unavailable.

And what about the residents in communities living around nuclear facilities like the Fernald plant? These people benefitted from an extensive 1990 study by the National Cancer Institute wherein nine hundred thousand cancer deaths in these potentially radiation-exposed communities were examined, then the change in their cancer mortality rates from 1950 until each facility began operation, and finally from the start-up year of that operation until 1984. There was no increased risk of cancer death for residents living in proximity to any nuclear installation in the United States. For childhood leukemia the risk of dying was actually greater *before* the start-up of nuclear facilities than after. *A radiation-related increase in cancer among the residents was never documented*. The Fernald Medical Monitoring Program confirmed these results in 1999. This program did discover an odd association of living near Fernald with systemic lupus erythematosus (but not with rheumatoid arthritis or similar autoimmune inflammatory diseases) and with a variety of non-malignant kidney diseases. There was no dose-response evidence produced for causality. [14] So the data tell us that some unlucky workers, and no residents, were eligible for compensation for cancers contracted from 1951 to the time of plant shut down and cleanup began, right?

Actually, wrong about the compensation! Uncle Sam may have a big heart, but probably the government foresaw multiple lengthy, hence expensive, lawsuits from former FMPC workers who were diagnosed with cancer. Some cancers in any population are, of course, inevitable, since there is a one in three lifetime risk of cancer in the U.S. So the Department of Labor stepped in and established a Special Exposure Cohort including all those individuals who had worked at Fernald for an arbitrary length of 250 days between 1951 and 1983. If any member of this FMPC employee group was diagnosed with one of twenty-two cancers, the legal presumption, unsupported by any data except for seven types of intestinal cancers, is now that radiation was also the cause of those other fifteen types of cancer. No dosimetric study to prove any radiation exposure is needed. All ex-workers with any of the twenty-two cancers listed in the legislation will receive $150,000 plus payment of medical expenses.[15]

Chapter Eleven: Grand Finale: Are Two heads Better Than One? Not Always!

And what about the thousand acre Fernald Preserve, the construction of which was finally completed in 2008. It is now one of the largest man-made wetlands in Ohio with open water, upland forests, a lengthy riparian corridor, 360 acres of grassland including a tallgrass prairie and savanna? Over two hundred species of birds have been observed here. There is now a grassy rolling hill at the east side of the Fernald Preserve where one must not picnic or hike, a mound 3000 feet long and 65 feet high which holds the low level radioactive waste too expensive to ship off site. It probably holds no health risk. But it is closely monitored for leakage of its contents. And the Great Miami Aquifer is still constantly sampled by impressive pump stations on site to remove the small amount of residual uranium from the water.

The Fernald plant site has vanished completely. In its place we have a lovely park. It has not exactly turned into a huge tourist attraction, but there are seven miles of safe hiking trails, an explanatory Visitor's Center, and great birding. And no two headed robins have been located—---yet.

So thank you, Albert Einstein, for without you we would not have this lovely, $4.4 billion park!

References

1. Hewlett RG, Anderson OE (1962). *The New World, 1939-1946.* University Park. Pennsylvania State University Press, pp. 10-75.
2. *Cincinnati Enquirer*, Feb. 11, 1996, p. 1.
3. Fernald at 50: From Weapons to Wetlands" Fluor Fernald Public Affairs Department, 2002.
4. *Cincinnati Post*, March 9, 1994, p. 1A, 3A.
5. Wildish, Mason, quoted by Robert McKay in "Fernald: The Enemy Is Us", *Cincinnati Magazine,* pp .116-2122, Jan., 1987.
6. Historical Radionuclide Releases from Current DOE Oak Ridge Operations Office Facilities, May, 1988.
7. Cincinnati Enquirer, March, 1989.
8. Westinghouse Gets 'D' Grade, Cincinnati Enquirer, March 23, 1990,p. D-1,D-2.
9. Wall Street Journal, Vol. 75, No. 182, p.1.
10. Cincinnati Enquirer, Jan. 14, 1995, p. A 4.
11. Preston DL, Ron E, Tokuoka S et al. Radiation Research 2007; 168: 1-64. Solid cancer incidence in atomic bomb survivors: 1958-1998.
12. Ritz B. Cancer mortality among workers exposed to chemicals during uranium processing. J Occup Environ Med 1999; 41:556-66.
13. Energy Employees Occupational Illness Compensation Program Act, October, 2000, Section 5, Parts B and E.

14. Lu-Frits P-Y, Katya LC, James, JA et al. Association of systemic lupus erythematosus with uranium exposure in a community living near a uranium- processing plant. Arthr. Rheum. 2014; 66: 3105-3112.